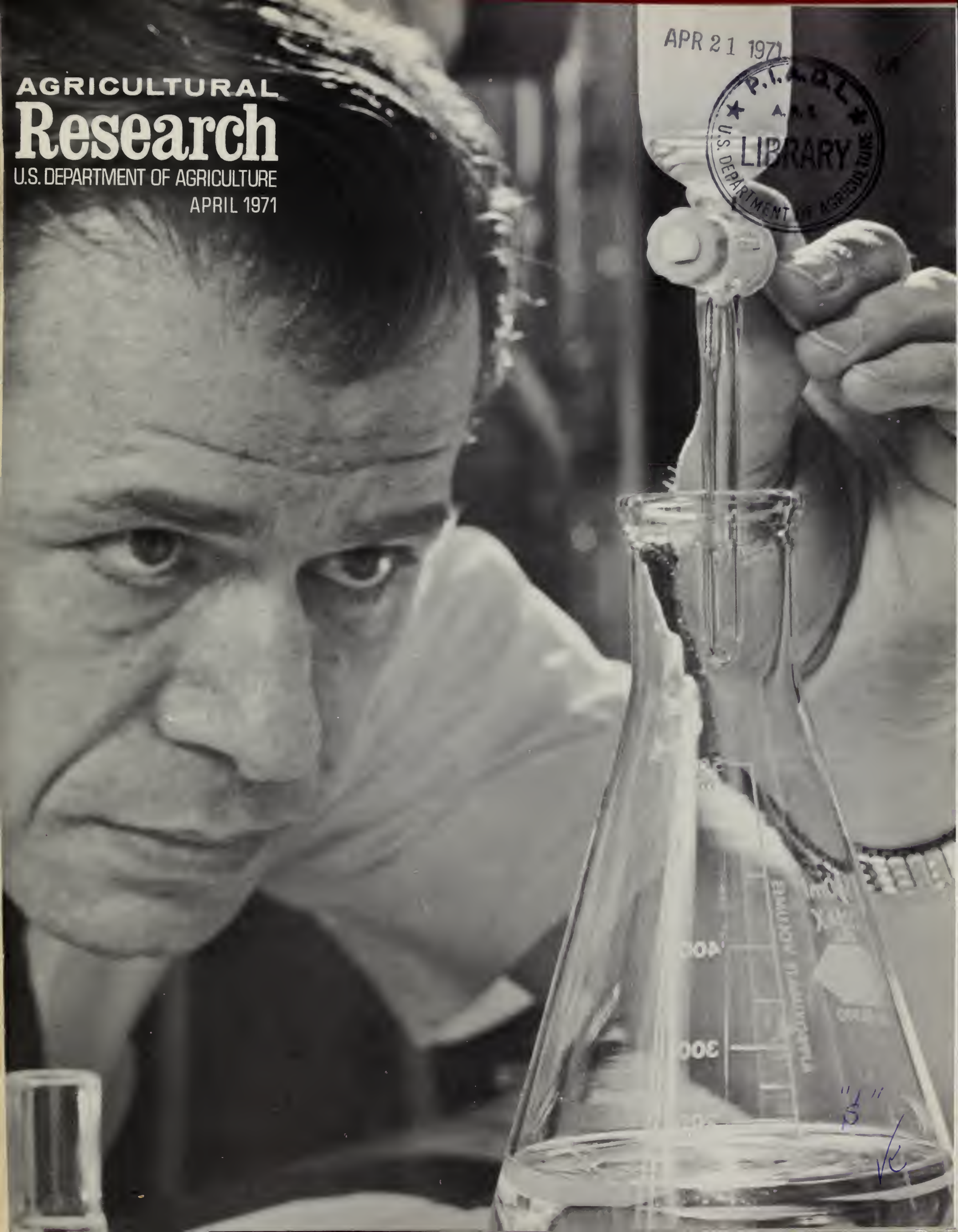


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AGRICULTURAL Research

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Queen of Forages

Alfalfa, a mainstay of today's agriculture, has a long history and a wide distribution at the hands of man. It is the only forage known to be cultivated since before the era of recorded history. From its homeland, probably in Iran, alfalfa came to Greece with the Persian legions under Darius. As the invaders conquered footholds, they sowed alfalfa to feed their chariot horses and fatten their cattle. Soldiers ate it too, boiling the succulent tops for greens or pottage. In time, alfalfa spread from Greece to Rome and eventually throughout most of Europe.

The Spaniards brought alfalfa to the New World, establishing it in Mexico and Peru where arid and alkaline soils resembled those of the plant's ancestral habitat. Two centuries later, colonists pitted the crop against the inhospitable acid soils and humid climate of the Atlantic seaboard. There was much experimentation, including plantings by Washington and Jefferson, but little success. Ironically, the 1849 California gold rush helped establish alfalfa in this country. Several eastern settlers who sailed the Cape Horn route to the west stopped in Chile where they obtained some seed. In California, they soon found that growing alfalfa paid better than digging gold—the alfalfa boom was on.

Alfalfa grew rank in California. Soon its lush growth mantled many acres in the Intermountain and Great Plains regions. However, as recently as 1900 only 1 percent of all U.S. alfalfa was grown east of the Mississippi River. Since then the picture has changed dramatically.

Shaping alfalfa into a national crop required years of effort by ARS and State scientists. Plant breeders played a vital role in expanding alfalfa acreage by developing winter-hardy varieties. They also developed alfalfas that incorporate multiple resistance to pests, as well as varieties resistant to the bacterial wilt that once devastated stands. These efforts were enhanced with the establishment of the National Foundation Seed Project which makes seed of improved varieties available to seed growers.

In utilization research, ARS scientists made many improvements in dehydrated alfalfa meal. More recently, they devised an experimental "wet process" for separating the valuable constituents of alfalfa, not only protein but also carotene and xanthophyll, two feed ingredients that impart yellow color to poultry. Looking to the future, the protein extraction process may prove important to human well-being, for alfalfa leaves yield more protein per acre than do seed crops. Chemurgy will undoubtedly find other uses for this versatile plant, truly the Queen of Forages.

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COVER: Dr. Jacobson utilizes gas chromatography to isolate one of the sex attractants of the southern armyworm (p. 8) (171A25-16).

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Clifford M. Hardin, Secretary
U.S. Department of Agriculture

G. W. Irving, Jr., Administrator
Agricultural Research Service



Between July 1966 and March 1970, USDA purchased and shipped more than 600,000 tons of the original CSM mix to over 100 countries (PN-1949).

for underdeveloped
countries

INFANT FORMULA MIX

THE CSM MIX, main course on USDA's Food for Peace table, is now available in a flavored, soluble form for infants. It is being distributed to critically hungry children and babies through the United Nation's Children's Fund (UNICEF).

Developed by ARS, the original CSM contains corn meal, soy flour, skim milk solids, vitamins, and minerals. In the original CSM mix, however, the soy flour and skim milk are completely processed, but the cornmeal is not, so the mix must be cooked where it is eaten. This limits its use in parts of the world where not only food but also the fuel for cooking it is hard to obtain.

And although the original CSM has properties desired in many foods prepared for children, it does not make the high-solids content, liquid formulae needed by infants and convalescent children. Their bellies simply won't hold enough dilute or bulky food to alleviate their critical hunger. To treat hunger at this stage, UNICEF workers insist on ingredients that give high-caloric density as well as high-protein level.

Studies at the ARS Northern marketing and nutrition research laboratory, Peoria, Ill., show that characteristics of CSM mixtures can be tailored by the method of cooking the cornmeal or

grits. Researchers were engineers Roy A. Anderson, Howard F. Conway, Earl B. Lancaster, Virgil F. Pfeifer, and Edward L. Griffin, Jr., and food technologist George N. Bookwalter. Food technologist Max Milner and engineer Ronald Hill represented UNICEF on the project.

The method they found best is called extrusion cooking. It was studied earlier as a way to cook soybeans for full-fat flour.

In this method, a screw turning in a hollow cylinder (as in a sausage grinder) compresses the food into less and less space and extrudes it through small holes. Cylinder and food temperatures can be regulated by heaters. The starchy food is subjected to high pressure and temperature for a short time.

Adapting a plastics extruder for their studies, the scientists found that corn grits containing 14 percent moisture are completely cooked in seconds at 370° F. and 2,000 to 4,000 pounds pressure per square inch.

Under these conditions, starch in the

corn breaks down, becoming more soluble in water. As a result, the corn forms a smooth liquid food in a much smaller amount of water than required for cooking raw starch. If less water is added, the food becomes more like cooked breakfast cereal.

UNICEF workers tried CSM mixtures made with extrusion-cooked corn in liquid formulae for infants and small children in India, Iraq, Madagascar, Thailand, and some African countries including Nigeria. They also tried extruded corn with cottonseed and fish products.

In Nigeria, UNICEF provided a precooked CSM mixture, with sugar and vanilla added, for preventing or curing kwashiorkor, a disease caused by severe malnutrition. Following emergency treatment, infants and convalescent children received precooked CSM until they could handle products such as ordinary CSM or a good family diet.

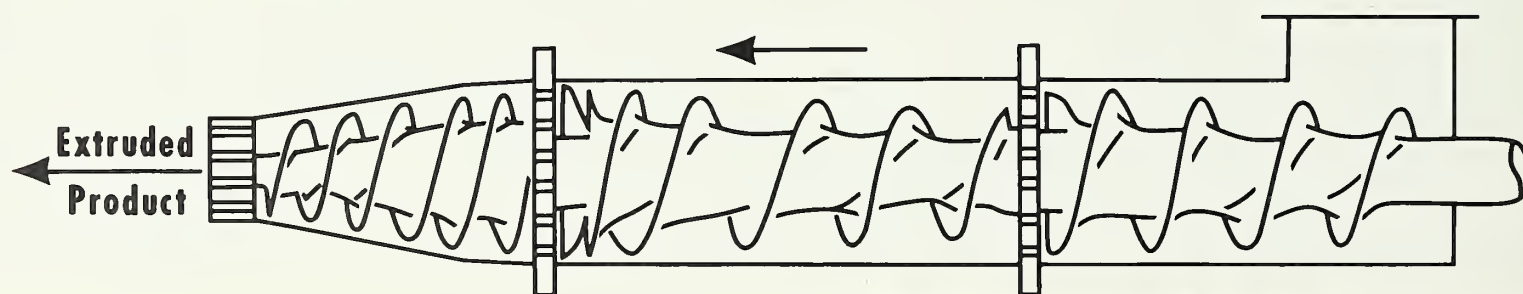
The precooked food proved "extremely valuable in cases of severe protein-calorie malnutrition once the acute

stage is over and a more substantial food can be fed," reported Miss I. Coenegracht, UNICEF nutritionist to Dr. Milner. "For moderate cases it is used right from the start of the treatment."

During a 4-month period, 536,000 Nigerian infants and children under 6 in hospitals or getting preventive treatment received precooked CSM with sugar and vanilla. Almost 95,000 convalescent and hospitalized children aged 6 to 12 years were fed. Miss Coenegracht said the children readily accepted the food and gained weight.

UNICEF used 110 tons of precooked, flavored CSM in its first tests and ordered an additional 750 tons last June. USDA and the Agency for International Development cooperated with UNICEF in putting 2,700 tons on the Food for Peace menu before the year ended.

The extrusion-cooked cornmeal and grits also show promise for domestic food programs and for commercial food products because of their flavor, nutrition, and convenience. ■



Above: In extrusion cooking, a screw turning in a hollow cylinder compresses the food into less and less space under high pressure and temperature (PN-1950).

Right: Engineer Howard T. Conway sends cornmeal through the extrusion cooker (PN-1951).



REVERSE OSMOSIS for the sugar bush

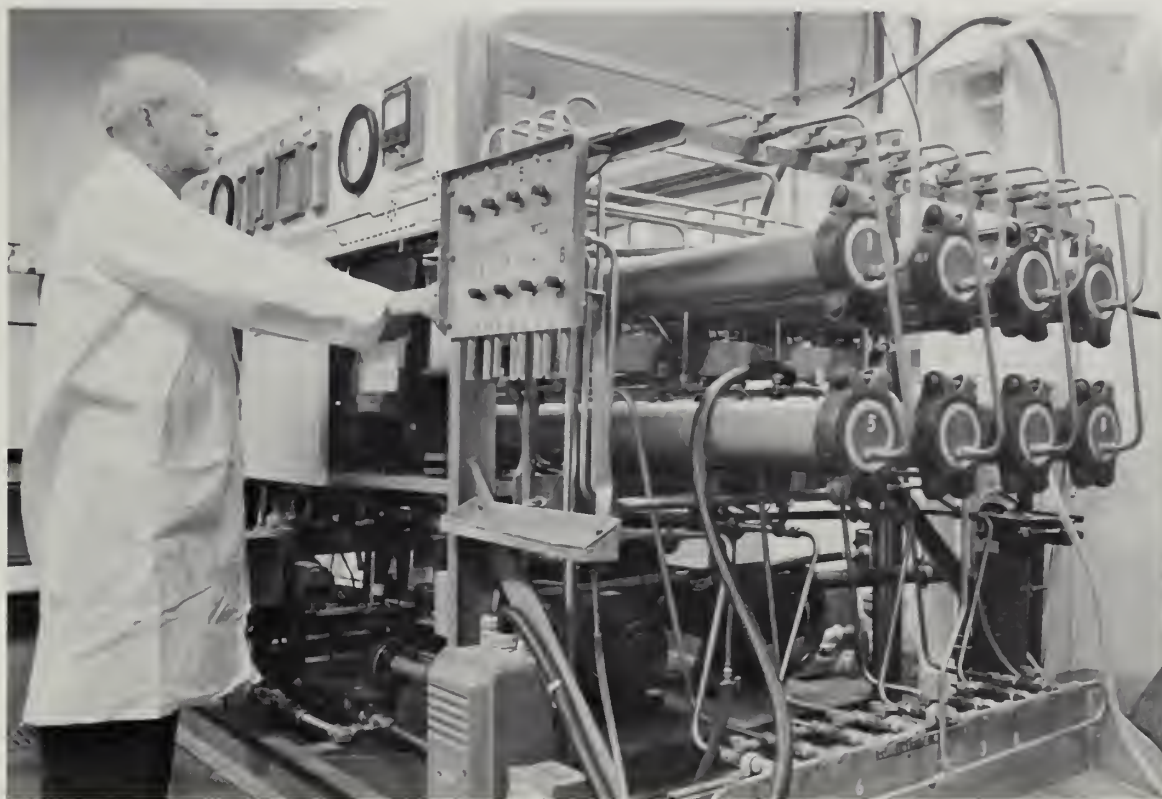
SINCE THE INDIAN first collected sap by gouging the bark of maple trees, the sap has been boiled to remove the water and concentrate it to sirup. Today, using large evaporators, sap is still concentrated by boiling. But reverse osmosis, a process first employed to make sea water potable, may replace a major part of the boiling operation.

Reverse osmosis concentrates the sap by forcing it, at high pressure, through a semipermeable membrane. The water flows through the membrane and exits in one stream; the sap is held back and exits in another. Up to 90 percent of the water could be removed this way.

To test reverse osmosis as a sap-concentrating process, chemist J. Clyde Underwood at the ARS Eastern marketing and nutrition research laboratory, Philadelphia, Pa., employed the specially built Eastern Utilization Reverse Osmosis Concentrator (EUROC). The EUROC was first conceived by Dr. Charles O. Willits, now retired.

The EUROC contains eight modules, each with three separate membrane assemblies. It was used during three seasons to concentrate over 100,000 gallons of sap in various sugar houses. In one season, for example, 55 percent of the water was removed from 10,000 gallons of sap at a rate of 360 gallons of sap per hour. The sap was then boiled down to the standard concentration for sirup, a step necessary to bring out the natural maple flavor.

The tests indicated that the energy cost for reverse osmosis may be only one twenty-fifth that for removing an equal amount of water conventionally. And the sirup made from the EUROC concentrated sap had the same delicious flavor and quality of sap concentrated by boiling. Also, because it reduced boiling time, the evaporation process could be better timed to eliminate overcooking. Only a maximum of one part per 500 of sap solids was lost in the effluent water during the operation.



Dr. Underwood adjusts pressure on the EUROC system. Numbered tubes contain the membranes. (1170A1054-7).

The EUROC also removed some of the "sugar sand" or calcium magnesium salts from the sap. Normally, these must be filtered out of the final sirup.

Two economic problems not yet determined are the cost of building a commercial-size EUROC and the life expectancy of the membranes. New and improved membranes, however, are being developed.

Sanitation also poses some problems with the EUROC. Now, the unit must be taken out of operation, rinsed with chlorine water, and then washed with 2,000 gallons of distilled water. Lost time is a major drawback in this type of cleaning. Scientists are seeking new, more suitable chemicals to eliminate residues and lingering odors.

One method of cutting down on bacterial growth is to expose the sap to ultraviolet light. ARS microbiologist John C. Kissinger found that irradiating the sap before it enters the EUROC eliminates 99 percent of the viable bacteria, thus lengthening the time the EUROC can be operated before cleaning is necessary. ■



Chemist Ransom A. Bell, Jr., takes a sample of sap out of the vat into which the sap flows after being concentrated by the EUROC. The sample will be tested for percent solids (1170A1059-1).



Research assistant Patricia A. Pilitt examines a tree peppered with holes left by shot-hole borers. The borers seek out raised and roughened areas of bark that contain soft spongy tissue more easily penetrated than smooth bark (1270X1236-4).

NEMATODES...answer to DUTCH ELM DISEASE?

WHEN an ARS nematologist examined shot-hole borers that had killed a peach tree, he found the insects, a species of bark beetle, to be parasitized by nematodes. Now, he is trying to manipulate these nematodes to attack a different tree insect—the bark beetle that carries Dutch elm disease from tree to tree.

The scientist, Dr. William B. Nickle, is hopeful that this bark beetle can be debilitated or sterilized effectively with parasitic nematodes. He theorizes that, like another nematized insect, the face fly of cattle (AGR. RES. May 1967, p. 8), these beetle populations might be reduced to a level where they would no longer be a major problem. The beetle has no nematode parasites at present, and in view of the suspension of DDT for elm bark beetle control, no highly effective chemical controls are available for use on this destructive pest.

In his initial studies, Dr. Nickle learned that the nematode parasites, *Neoparasitylenchus rugulosi*, affect the reproductive behavior of shot-hole borers and finally kill them.

Normally, a female shot-hole borer penetrates the bark of a fruit tree, leaving a shot-size hole. She then makes a gallery about an inch long parallel to the tree stem and lays eggs on both sides of the gallery. After hatching, the new insect larvae mine out lateral tunnels from the sides of the gallery, forming a pattern resembling legs on a centipede. Heavy infestations, especially on trees already weakened by drought, wind, or mechanical injury, rapidly kill fruit trees such as cherry, peach, pear, apple, and choke cherry.

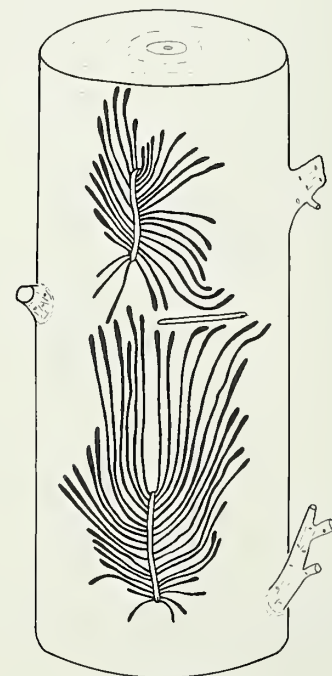
However, Dr. Nickle learned that when the female beetle is parasitized by the nematode, she makes horizontal galleries and doesn't lay eggs. After she

dies, hundreds of nematodes emerge from her head.

These emerging nematodes are fourth-stage male and female larvae which molt, become adults, and mate within 2 to 3 days in the gallery. Then the males die. The impregnated female nematode seeks out a larval bark beetle in a nearby gallery and enters the insect's body to start a new infestation. Inside the insect's body, the nematode takes nourishment and expands into the large, swollen, egg-producing form.

About the time the beetle becomes adult, the female nematode inside the insect lays her eggs. After hatching, the young nematodes continue growing and eventually exit from the beetle's head. The beetle is killed after she has transported the nematodes to a new gallery system where the nearby healthy beetles are attacked. ■

Normal borer galleries run parallel to the branch with lateral lines formed by larvae. Parasitized borers mine horizontal galleries without lateral lines (PN-1952).



ALFALFA for ALASKA

MORE than 20 years of research to develop a winter-hardy alfalfa for Alaska is beginning to pay off.

A selection of variegated alfalfa, designated A-syn.B, showed 46- to 99-percent winter survival in test plantings in south central and interior Alaska. ARS agronomists Leslie J. Klebesadel and Roscoe L. Taylor say these results indicate substantial progress toward acclimatizing alfalfa to Alaska.

Stabilization and expansion of livestock production in the 49th State are hampered by inability to grow perennial forage legumes. Varieties and strains that are hardy in cold climates in the lower 48 States survive poorly if at all in Alaska. The winter temperatures may be similar, but alfalfas must also be adapted to Alaska's short photoperiods.

To adapt alfalfa to subarctic climate, ARS and Alaska Agricultural Experiment Station scientists at Palmer and College began introducing alfalfas from many sources more than 20 years ago. After initial screening for hardiness, former ARS agronomist John C. Brinsmade transplanted survivors from the best lines to an isolation nursery at College. Polycross seed from surviving plants in the nursery was then increased as A-syn.B.

Laboratory tests with clipped seedlings removed from the field in October demonstrated the tolerance of A-syn.B to artificial freezing. Tissue injury was only 31 percent, as measured by electrical conductance, compared with 58 percent for Vernal, one of the most winter-hardy varieties from the lower 48 States.

Winter survival of variegated alfalfa

appears to be correlated with the total amount of stored food reserves. Dr. Klebesadel measured food reserves by weighing fall regrowth from taproot-crown segments of field-grown seedlings. Regrowth in a dark chamber was harvested and weighed every 2 weeks until reserves were exhausted. A-syn.B averaged 157 milligrams regrowth; less hardy Canadian varieties Rhizoma and Rambler averaged 136 and 134 mg.

In a field test at an exposed site representative of conditions in Alaska's Matanuska Valley, A-syn.B's 52 percent survival was significantly better than that of 33 other strains, including the most winter-hardy alfalfas known. Although 27 percent of Teton, a hardy variety in the Intermountain area, survived, none of the other alfalfas that were field-tested achieved more than 13 percent winter survival.

At a sheltered location, A-syn.B survival was 99 percent, and its average in five tests at Palmer and College was 75 percent. Teton averaged 49 percent.

The critical influence on hardiness appears to be the length of growing season after photoperiods are short enough to trigger hardiness development. At Palmer, 24° F. or lower temperatures usually occur within 2 weeks after photoperiods have shortened to less than 12 hours. Two weeks is too brief an interval for alfalfas adapted to southern latitudes to achieve maximum hardiness.

A-syn.B is a selection within temperate-adapted alfalfas that is able to achieve a high level of hardiness development under the unique photoperiod-temperature combination that prevails in late summer and autumn at 61° to 63° north latitudes. ■

Mr. Taylor interpollinates selected clones from alfalfas that have demonstrated superior persistence in Alaska tests. Dr. Klebesadel looks on (BN-37505).



LURING THE SOUTHERN ARMYWORM

THE female southern armyworm performs a rare feat among insects employing compounds called pheromones to attract mates: She produces two pheromones that, individually, excite males and when combined, lure the males to the female.

Her pheromones were discovered in research that could help prevent environmental pollution if they prove effective in traps for detection and perhaps control. Early detection may reduce both the amount of insecticide and number of applications needed to combat these serious pests of vegetables, corn, and other crops.

The southern armyworm's two sex attractants were isolated, identified, and synthesized by a team of four scientists: Chemist Martin Jacobson and entomologist Robert E. Redfern of ARS at Beltsville, Md., and chemists William A. Jones and Mary H. Aldridge of American University, Washington, D.C. Dr. Jones worked with both ARS and the University.

Hundreds of insect species are believed to produce sex attractants, but the lures of only 30 species have previously been isolated, identified, and produced synthetically. This indicates the extreme difficulty of determining which of thousands of natural chemical compounds found in insects is the active material in a lure.

In the study the chemists discovered that one of the southern armyworm's attractants is the same as that identified earlier for the fall armyworm by other ARS scientists (AGR. RES., Nov. 1967, p. 15). The two crop pests are related species.

The first pheromone identified for

the southern armyworm was named "prodenialure A" or *cis*-9-tetradecen-1-ol acetate. This is the same as the lure produced by the fall armyworm. The second pheromone, "prodenialure B" or *cis*-9,trans-12-tetradecadien-1-ol acetate, is more active than the first lure when males are exposed to it in the laboratory.

The two lures were identified from extracts that were taken from 305,000 abdominal tips of female moths. Tips yielded about 4 milligrams of prodenialure A and 0.8 mg. of prodenialure B.

In laboratory tests, the synthetic lures produced the same response by males as did the natural lures. Field tests revealed a different response, however. Although each lure alone attracted males in the laboratory, it excited but did not attract them to traps in field tests. However, males were attracted to traps which were baited with both lures combined.

Further tests must be made to determine the potential of the lures for use in surveys or control of the southern armyworm. ■

Mr. Redfern releases sex pheromone vapors into cage of moths to test reaction. Mature male moths are active only at night and will not respond to the lure in the light. Moths are placed in darkness as soon as they emerge from cocoons and tests are carried out 2 days later (171A26-14).





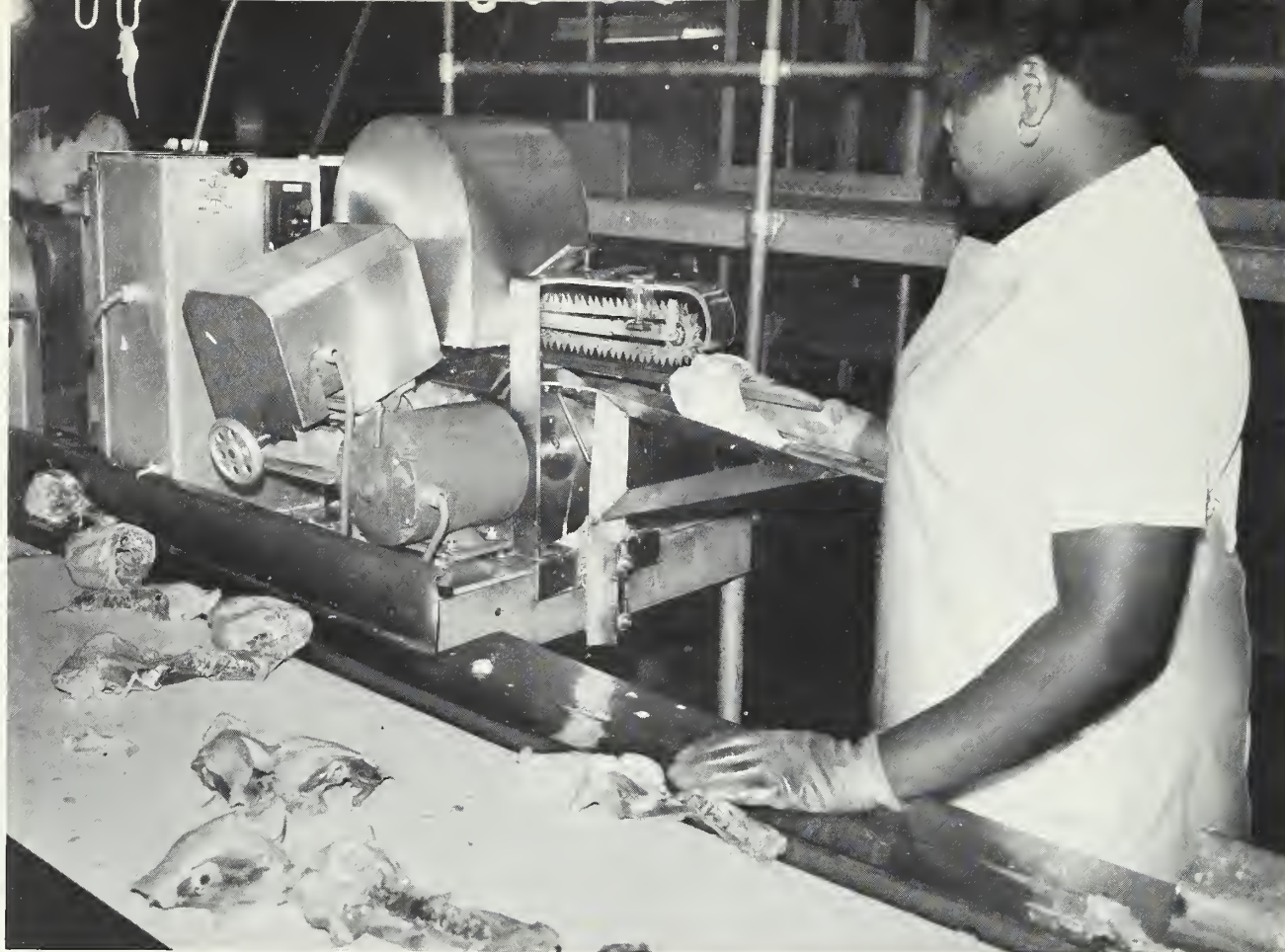
Mr. Redfern counts and removes moths which were attracted to small quantities of the sex pheromones and trapped in the sticky substance applied on the sides of the tubular trap (171A26-2).

Southern armyworm chews its way through the leaf of a bean plant. The insect, a species of climbing cutworm, produces four or more generations a year and feeds on buds, leaves and fruits of vegetable, orchard and vineyard crops (171A25-19).



Male southern armyworms exhibit typical mating response to fumes of synthetic lure (171A26-7).

Factory workers run chicken breasts through the new cut-up machine. The machine rates high on safety because workers simply feed in the birds; they do not go near the blades. Tests indicate that a production rate of 25 birds per minute can be expected with a minimum of 90 percent USDA grade A parts (BN-37687).

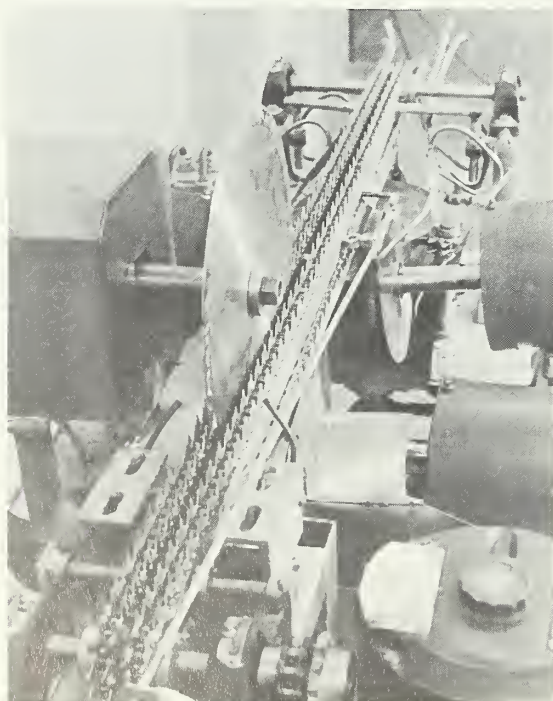


BROILER CUT-UP MACHINE

HAZARDOUS butcher knives and power saws soon may be making way for a chicken cut-up machine that promises to help broiler processors, who are beset by rising labor costs and a dwindling labor force.

The machine is expected to cut man-

Detail of the conveyor and one of the blades (0271A123-27).



power requirements by almost half, increase worker safety, and raise production. Faster processing would also reduce spoilage and contamination hazards. An average commercial plant should save about \$20,000 a year with the new equipment.

Twenty years ago when labor was more plentiful and operating costs lower, the knife and saw methods were adequate to handle production requirements. But no longer. Last year some 3 billion broilers, or about five times as many as in 1950, were produced. About a third of these were further processed for supermarkets, the fast-food industry (firms specializing in selling cut-up, ready-to-eat chicken), and for other convenience food outlets.

The new machine is designed to better serve this expanding market. Basically, this is how it works. The carcass is threaded by hand onto a triangular bar that fits inside the body cavity. The bar guides and holds the bird securely to insure precision cuts, while it moves by a spiked-tooth conveying chain

through a series of specially positioned rotary cutting blades.

The machine can be set to cut 30 whole birds a minute into halves or quarters, or into five pieces—two whole legs, two breast halves, and the backbone; or at 15 per minute into nine pieces—two wings, two drumsticks, two thighs, and three breast portions. Actually, the cutting device can be grouped into almost any combination to further cut whole or halved chickens into any special cuts desired by the processor. For instance, the breast portion can be run through the machine with the wings removed so that the backbone will be taken out and the breast split into halves.

The machine was developed at the Richard B. Russell Agricultural Engineering Research Center, Athens, Ga. It was designed by ARS industrial engineers Rex E. Childs and A. Donald Shackelford, and by ARS engineering technician E. J. Lloyd, who is credited with working out most of the machine's structural features. ■

Quicker, cheaper technique for DIAGNOSING PULLORUM

PULLORUM, a virulent poultry disease can be diagnosed at half of the cost and much faster than by the method now used with no loss in accuracy.

Thanks largely to long-established and routine blood testing and sanitation programs for pullorum, outbreaks are not common in the United States. This infectious bacterial disease is usually fatal to chicks and poults, but adults will generally just pass it on through the ovary to offspring.

Basis of the pullorum diagnostic technique, both old and new, is agglutination—the clumping reaction of bacterial cells suspended in various fluids. The traditional macrotest version, used with slight modification for nearly 60 years, is done in test tubes, which must be handled individually and washed or disposed of after tests are read.

The newly adapted microtest is essentially the same as the macrotest, but with a three-fourths reduction in the volumes of reagents, and the use of a special, purple-stained bacterial cell suspension for mixing with serum to be tested. The stained bacterial cell suspension was the ARS contribution; microtesting itself is long established.

Veterinary scientist James E. Williams and laboratory technician Alton D. Whittemore, both at the ARS Southeast Poultry Research Laboratory, Athens, Ga., conducted the research in cooperation with ARS poultry scientists there.

The traditional test employs separate test tubes arranged in racks for each sample, but microtest sample drops are analyzed on disposable, small plastic plates which have 96 tiny depressions in them. Thus, the microtest equipment takes much less space. A hundred microplates, enough for 9,600 tests, can be stored in an area about the size of a

small box—13 by 11 by 8 inches.

Time savings also accrue in microtesting. While reading the macrotest results requires separate examination of groups of tubes, all 96 tests per microplate can be interpreted at once, reducing reading time to at least a tenth that of the macrotest. In addition, time for arranging test tubes in racks and washing dirty tubes is eliminated.

Time and space savings also lead to considerable reduction in testing costs. From a national survey of pullorum testing laboratories, the scientists found that cost of traditional macrotests averaged about 7 cents per test, compared to half that amount—3.3 cents per test—for the microtest.

In six Northeast States where the traditional method is used exclusively, the micromethod would have saved about \$83,000 during fiscal 1970.

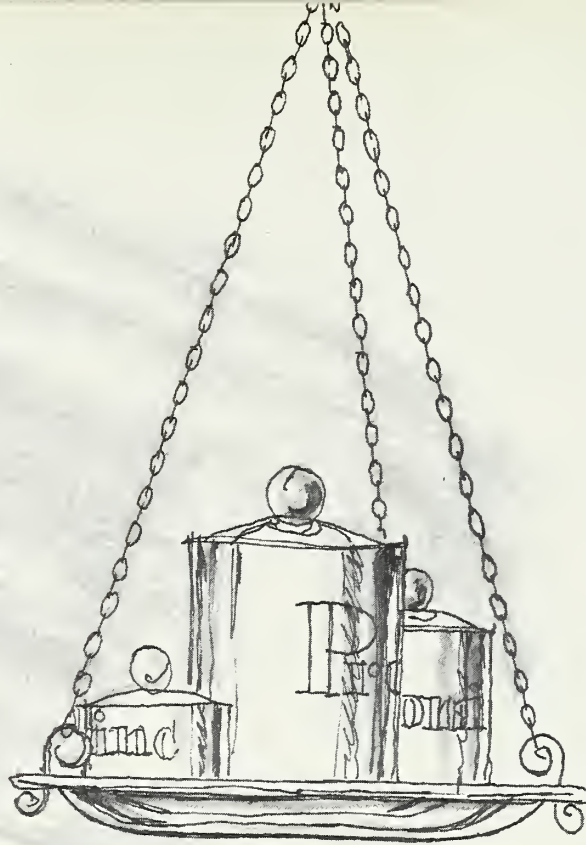
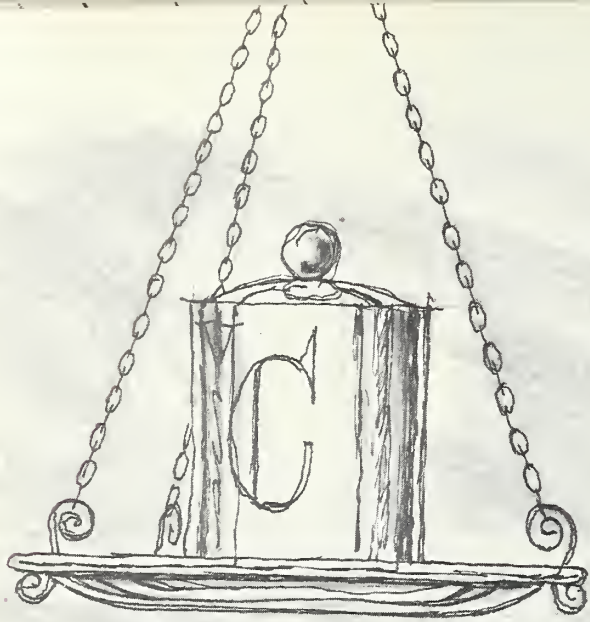
And as an added bonus, an inexperienced worker can quickly be trained in the use of the microtest. ■



Above: Dr. Williams checks macrotest results. Each tube is handled manually and viewed individually (0271A122-5).

Below: In the microtest, results are read using a mirror that reflects the bottom of the plates. All 96 wells can be viewed and read at one time (0271A126-7).





VITAMIN C/ part of a nutrient balance

WHEN A LITTLE is good, more is better. True or false? In the case of protein and trace minerals combined with vitamin C in the diet, the answer is "false."

Dietary tests with guinea pigs and rats indicate that excessive amounts of protein and trace elements inhibit vitamin C metabolism. Future experiments with humans may prove, however, that to compensate for a high-protein diet, greater amounts of vitamin C should be included. The tests were conducted in India under a Public Law 480 grant from ARS.

Guinea pigs, like man and other primates, cannot synthesize vitamin C from glucose and, therefore, must eat foods that contain the vitamin. Rats, like many other mammals, have the necessary enzyme to convert L-Gulonolactone—a carbohydrate derived from glucose—to vitamin C.

To measure response to test diets, growth rate and the concentration of enzymes involved in synthesizing and degrading vitamin C in liver, kidney, and adrenal tissues were used.

In the tests, guinea pigs received dietary supplements of vitamin C and the milk protein, casein. Up to 25-percent casein progressively increased weight gain and concentrations of vitamin C in body tissues. However, when casein was increased to 60 percent, comparable growth rates and vitamin C concentrations decreased. Results were similar in rats.

Although trace minerals such as zinc, copper, cobalt, and manganese are es-

sential for good health, too much of these minerals also proved detrimental.

Adding 150 parts per million (ppm) of zinc to the diet improved vitamin C metabolism. The same was true of copper at 25 ppm, and chromium and tungsten at 5 ppm each. But higher than normal levels—zinc at 1,500 ppm or copper at 250 ppm, for example—decreased vitamin C content and lowered enzyme activity.

Of the other trace elements tested, low amounts of both manganese and cobalt also stimulated vitamin C metabolism. Too much molybdenum, a constituent of certain enzymes and, therefore, considered an essential trace mineral in human metabolism, proved toxic.

Dr. Ruth M. Leverton, ARS sponsoring scientist, Washington, D.C., says the Indian research has not only advanced the understanding of vitamin C metabolism, it has also emphasized the importance of knowing more about the reciprocal activity of different nutrients in the diet. We may know a great deal about nutrients in isolation, but the interrelationships of nutrients in body metabolism are largely unexplored.

Investigators for this project, conducted at Calcutta University's College of Science and Technology, were Dr. N. C. Ghosh, and Dr. G. C. Chatterjee under the direction of Dr. S. C. Niyogy.

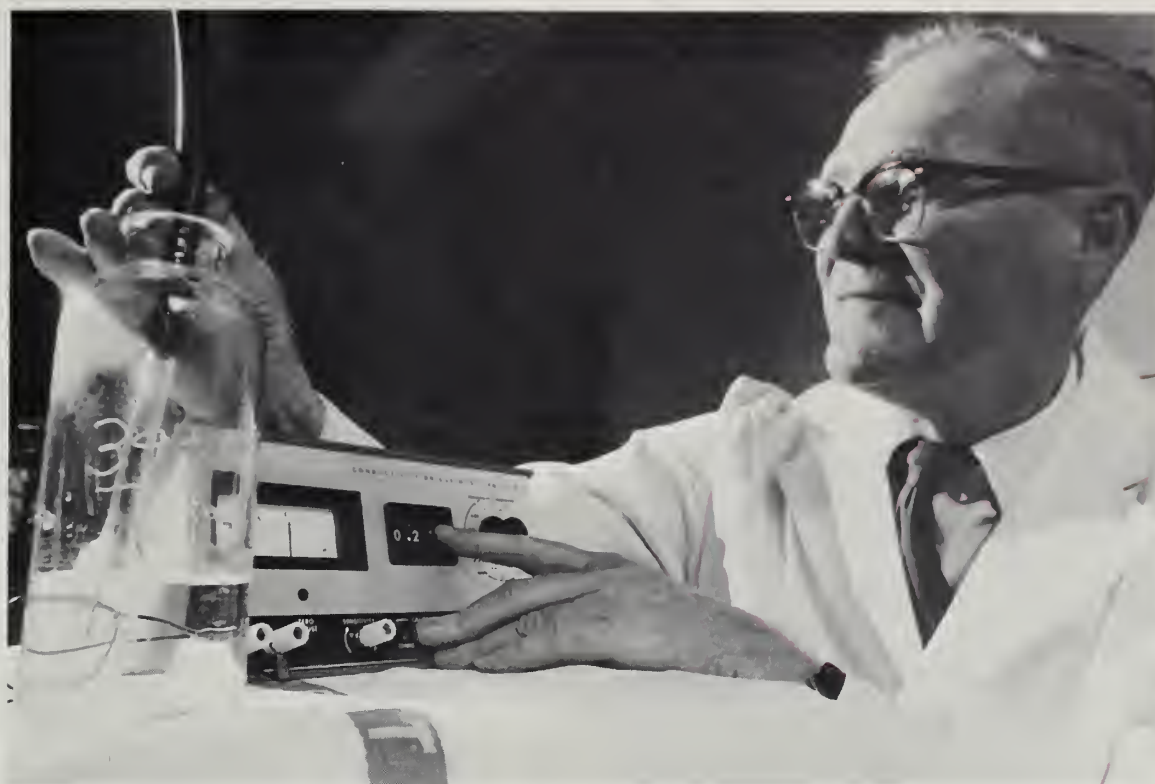
Vitamin C is a threshold substance; it is not excreted by the kidney until the level in the blood exceeds a certain amount. This amount depends on the extent of vitamin C concentration in body tissues. Unlike some other vitamins, it cannot be stored.

Lack of vitamin C causes scurvy, which is characterized by swollen joints, bleeding gums, loose teeth, bone lesions, anemia, emaciation,

and death. Normally, such extreme deficiencies do not occur in U.S. diets, but lesser deficiencies will cause slow healing of wounds and decrease ability to metabolize amino acids.

Despite abundant supplies of citrus fruits and green vegetables in America, surveys in the United States have indicated that some diets adequate in other nutrients may not include enough vitamin C.

QUICK TEST for CORN DUST



Mr. Greenaway measures conductivity of filtrate solution before the dust is added (PN-1954).

FIRE, explosions, and air pollution are sometimes associated with stored corn containing large quantities of dust. Present tests for chaff and foreign matter in grain, however, indicate only roughly the dust content. A new test can now measure it accurately and rapidly.

This test may help establish standards to judge complaints by foreign purchasers that our grain is sometimes too dusty. It could also be used to assess workers' claims for extra pay to compensate for dust-caused injury to the eyes, nose, throat, and lungs. In addition, the test may help in establishing specific tolerances for dust content to protect the health of workmen and eliminate possible dangers of fire and explosion.

ARS chemist Walter T. Greenaway at Beltsville, Md., developed the test specifically for use with corn. It costs about 10 cents to make, and little training or experience is needed. Necessary equipment can be readily obtained for about \$250 and set up at any location where grain is handled. Further experiments are underway to adapt the test to other grains—wheat, oats, barley, sorghum, rye, soybeans, and flaxseed.

In the dust test for corn, a 7-ounce sample is covered with a funnel connected by hose to a small air pump. The funnel is moved by hand over the corn in a circular motion for 30 seconds while the pump, acting like a vacuum cleaner, draws dust from the corn through a wire sieve in the funnel, straining out particles larger than about $\frac{1}{32}$ inch. Particles that pass through the sieve are sucked into a bottle of water.

Although the cloudiness of the resulting suspension gives a readily visible indication of the dust content, an objective analysis is obtained by measuring the electrical conductivity of the water before and after the dust is trapped. Minerals in the dust dissolve in the water, increasing its conductivity. The differences in conductivity are recorded on the dial of a meter and are then converted into percent dust by referring to a calibrated chart.

The new test, requiring about 3 minutes, is only slightly less precise than an experimental procedure that was developed earlier. In that test, the trapped dust particles were collected by centrifuge, dried for 1 hour, and then weighed. ■

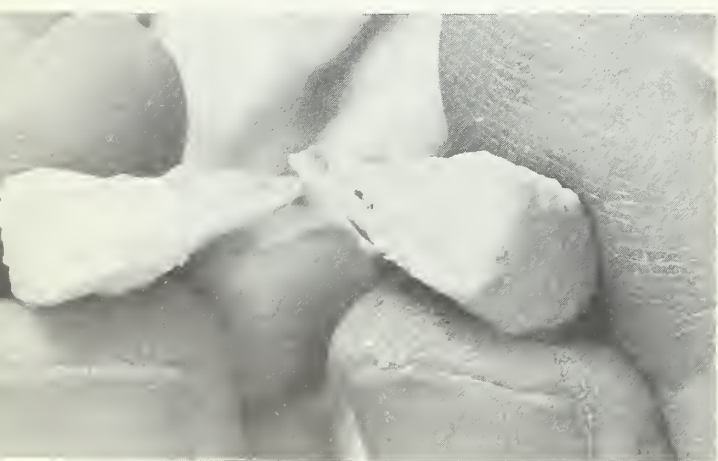


Vacuum pump sucks dust from grain sample for absorption into filtrate solution. Microscopic examinations of dust showed that it contained mostly starch cells and small particles of bran. This suggests that the dust problem might be solved by more careful harvesting and shelling methods to minimize kernel breakage (0271X113-9).

Mr. Strolle inspects apple pieces as they emerge from puffing gun. In explosion puffing, fruit or vegetable pieces are rotated in a drum until a certain temperature and pressure are reached; then the pieces are ejected and part of the water immediately vaporizes. Heat is used to remove the rest of the water. The method cuts processing time from 20 minutes or more to 5 or 6 minutes (1170A1056-22).



Mr. Strolle breaks apple snack that has kept crisp after being subjected to 75-percent humidity and 90° F. temperature in humidor at right (1170A1064-13).



Broken apple snack reveals porous structure characteristic of explosion puffing. This structure takes up water quickly (1170A1064-2).



New: Apple snacks

CRISP, crunchy apple snacks can be made with explosion-puffed apple pieces, now that a way has been found to retain their crispness.

Explosion-puffed apple pieces can be baked into pies and other pastries or eaten as a snack. High heat and humidity, however, may cause them to become soft and sticky and to rapidly lose their snack appeal. Loss of crispness is due to the uptake of water by the monosaccharide sugars which are highly concentrated in the apples. Replacing part of these sugars with sucrose increases moisture tolerance so that apple pieces remain crisp longer.

ARS chemical engineer Eugene O. Strolle of the Eastern marketing and nutrition research laboratory, Philadelphia, Pa., developed a process for substituting sucrose, which normally

comprises 20 to 30 percent of the total sugars of the apples, for monosaccharides, which make up the rest of the apple sugars.

To reduce the amount of monosaccharides, the apple pieces are soaked in tap water for 3 to 6 hours. Then they are bathed in a solution of 20- to 40-percent sucrose several hours longer to increase the sucrose content by osmosis. After soaking, the apple pieces are partially dried, explosion-puffed, and dried again in hot air.

Tests on moisture uptake showed that treated pieces lost their crispness at 6.6 percent moisture; the untreated pieces, at 4.3 percent moisture.

At 75 percent relative humidity and 90° F., the untreated pieces became soft in less than 1 hour while the treated pieces remained crisp for 2 hours. ■

AGRISEARCH NOTES

Shearlings prove superior bedpads

Three years of tests in professional institutions have convinced ARS scientists that glutaraldehyde-tanned shearling bedpads are far superior to any other product.

The specially tanned shearlings, sheepskins with the wool evenly clipped, were found to be effective nursing aids for preventing and healing bedsores. The painful sores develop in patients who cannot move and must lie for hours in one position.

Shearlings have long been recognized as ideal bedpads, but before the development of glutaraldehyde tanning (AGR. RES. December 1965, p. 8), the pads were tanned by conventional methods and shrank and hardened after a few launderings. The glutaraldehyde-tanned shearlings, however, can be run through a washer and dryer as many as 54 times and still retain their original shape and resiliency.

Both patients and staff in eight hospitals, a nursing home, and an outpatient clinic highly praised the new washable bedpads. The shearlings were serviceable for as long as 28 months and proved more effective than bedpads made from synthetic fibers.

When in use, the wool of the shearling is placed in direct contact with the patient's skin. This allows for free circulation of air and absorption of perspiration. It also minimizes skin abrasion, thereby aiding in preventing and in healing the bedsores. The pads are resilient and distribute the weight of the patients evenly. The wool is highly

flame-retardant—an important safety factor for the bedridden or disabled patient.

ARS chemist William F. Happich and his associates at the Eastern marketing and nutrition laboratory who developed the glutaraldehyde tanning process for shearlings, conducted the tests in the Philadelphia Pa., area in close cooperation with nursing administrators.

Laser marks fish

Laser beams may be the branding iron of the future.

Veterinarian R. Keith Farrell of the ARS Endoparasite Vector Pioneering Research Laboratory, Pullman, Wash., has used the laser as an inexpensive and simple method of identifying fish for

scientific studies of their migration.

In preliminary tests, the laser instantaneously produced white marks that slowly darkened with age. Dr. Farrell concluded that this procedure could be adapted to automated, short-term markings.

The laser destroys dark pigment-producing cells on the surface. Examinations have proven that other surface cells reflect enough light to act as a barrier to the laser, thus sparing deeper pigment cells.

Current studies should lead to successful adaptation of the technique for the fisheries industry. Laser light has also been used to mark animals. In experiments with dogs, both hair and skin instantly and painlessly turned white. The marks were considered permanent.



Registered nurse Beatrice A. Jones, administrator of a nursing home, checks on the comfort of Mrs. Anna T. Newnam. Shearling bedpads placed in wheelchairs help prevent bedsores (PN-1953).

AGRISEARCH NOTES

Little fertilizer lost by leaching

Little nitrate-nitrogen was lost to drain lines in a 40-acre Texas citrus orchard even though the over-fertilized plot was leached with irrigation water to remove salt build-up.

Nitrogen as ammonium nitrate was applied at 400 pounds per acre (lbs/a) to 2-acre plots, but only 16 lbs/a nitrate nitrogen (4.0 percent) found its way to the lines.

Nitrate-nitrogen losses ranged from 0.01 to 0.30 lbs/a a day during 190 days of intermittent drain line flow.

ARS soil scientists George W. Langdale and James R. Thomas, Weslaco, Tex., say there is little chance of enriching drainage effluents with nitrate-nitrogen while leaching if recommended rates of nitrogen fertilizer (125 to 175 lbs/a in that area) are used.

Herbicides for winter cabbage

Winter cabbage growers in Texas can look forward to higher yields and better quality crops, thanks to two herbicides that have provided outstanding control on several major weeds.

In Texas, one of the largest producing areas of winter cabbage, field tests showed that both bensulide and trifluralin were highly effective in controlling Palmer amaranth, redroot pigweed, common purslane, barnyardgrass, and other weeds.

The herbicides were two of five tested for performance when applied on soil

surfaces or incorporated 1 to 3 inches deep. The other compounds—DCPA, CDEC, and diphenamid—were less effective in the tests.

Bensulide incorporated into the soil provided excellent control at all depths, but trifluralin worked better when incorporated to a depth of 3 inches.

Soil surface applications of the two compounds provided adequate control when rainfall occurred soon after treatment.

The research was conducted by ARS horticulturist Robert M. Menges in cooperation with agronomist Jack L. Hubbard of the Texas Agricultural Experiment Station, Weslaco. All herbicides tested are registered for use on cabbage except diphenamid.

Improved wool from crossbreds?

Hybrid vigor, the usually beneficial response in an animal to the cross of parents carrying many unlike genes, may affect some of the economically important fleece traits in sheep.

ARS geneticist George M. Sidwell analyzed fleece data on 404 yearling ewes at Beltsville, Md., with biometrician Ruel L. Wilson and fiber technologist Mary E. Hourihan. Traits studied were staple length, grease and clean fleece weight, fiber diameter, and variability of fiber diameter.

Although the effect of hybrid vigor on wool traits was not as clear cut as for such traits as reproductive rate and livability, the scientists found that in all crosses but one, both grease and clean fleece weight were increased. They also

noted that more hybrid vigor was exhibited in some crosses than in others.

Data included four purebred groups—Hampshire, Targhee, Dorset, and Suffolk; one strain from a Columbia-Southdale cross; seven groups of 2-breed crosses; and two groups of 3-breed cross ewes. For grease and clear fleece weight, the results ranged from a 27-percent increase with the Hampshire × Columbia-Southdale cross to a slight loss in weight with the Suffolk × Targhee cross.

Staple length increased in four out of seven of the 2-breed crosses; fiber diameter increased in five out of seven of the 2-breed crosses. Variability of fiber diameter decreased with crossbreeding in four of the seven 2-breed crosses and in one of the 3-breed crosses.



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Use all pesticides selectively and carefully.